PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-280007

(43)Date of publication of application : 27.09.2002

(51)Int.Cl. H01M 8/00
B60L 11/18
H01M 8/02
H01M 8/04
H01M 8/06
H01M 8/12

(21)Application number : 2001-387934

(22)Date of filing : 20.12.2001

(71)Applicant : MITSUBISHI MATERIALS CORP

(72)Inventor : AKIKUSA JUN
HOSHINO KOJI

(30)Priority

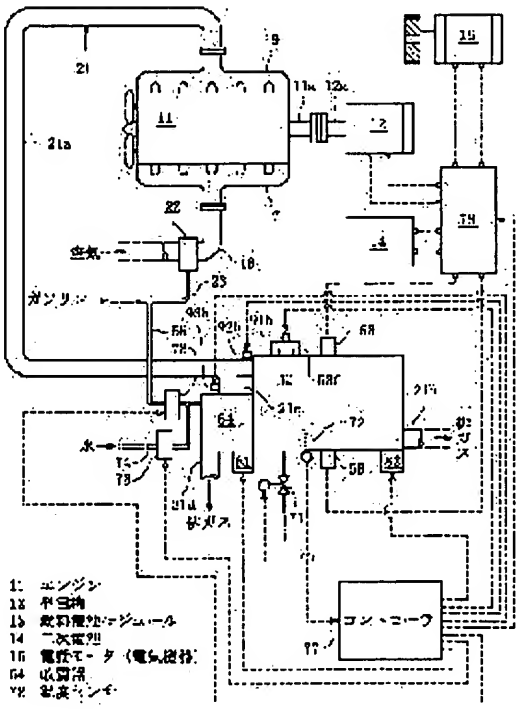
Priority number : 2000402475 Priority date : 28.12.2000 Priority country : JP

(54) HYBRID POWER SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To use gasoline, light oil, or the like supplied in a usual gasoline station as a row material of fuel gas supplied to a fuel cell module.

SOLUTION: Mixture gas of fuel gas vaporized from hydrocarbon and air is burned in an engine 11 to generate mechanical power. The fuel gas obtained by reforming hydrocarbon is supplied to a fuel electrode layer of a fuel cell module 13 fabricated by stacking a plurality of power generating cells each comprising a solid electrolyte layer, and a fuel electrode layer and an air electrode layer placed on each side of the solid electrolyte layer, and air or oxygen is supplied to the air electrode layer. Thereby, the fuel cell module 13 generates power at 930°C or lower. Either one or both of mechanical power generated in the engine 11 and electric power generated in the fuel cell module 13 are outputted.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the hybrid power system which used the fuel cell module of a solid acid ghost mold.
[0002]
[Description of the Prior Art] Conventionally, the burner of a refining machine heats and decomposes the raw material which uses liquid fuel and water as a principal component, and hydrogen gas is generated. While the fuel cell with which the fuel electrode and the oxygen electrode were arranged in both sides of an electrolyte layer incorporates and generates the hydrogen gas generated with the refining vessel to a fuel electrode, steady power is supplied to a predetermined load. A rechargeable battery supplies necessary power to a load at least at the time of load start up or a load effect, and the fuel cell generation-of-electrical-energy system by which the electric power supply change means was constituted further possible [a change of the electric power supply from a fuel cell and a rechargeable battery] is indicated (JP,6-140065,A). A fuel cell heating means to lead the combustion gas which the burner of a refining machine injected to a fuel cell is established, and it consists of this fuel cell generation-of-electrical-energy system so that it may be heated with this fuel cell heating means by the temperature (a generation of electrical energy is possible) which can put a fuel cell into operation. Moreover, an electrolyte layer is formed by the macromolecule membrane system which has ion conductivity, and a methanol is used as liquid fuel.
[0003] Thus, in the constituted fuel cell generation-of-electrical-energy system, since the time amount to generation-of-electrical-energy initiation of a fuel cell can be substantially shortened by heating a fuel cell with the combustion gas of the burner used for a hydrogen generate time with a refining vessel until it reaches predetermined temperature, improvement in the generation efficiency of a fuel cell can be aimed at. Moreover, since the electric power supply from a rechargeable battery can be reduced by this, the number of rechargeable batteries can be reduced and a compact and lightweight fuel cell generation-of-electrical-energy system is obtained.
[0004]
[Problem(s) to be Solved by the Invention] However, in the fuel cell generation-of-electrical-energy system shown in above-mentioned conventional JP,6-140065,A, since the raw material of the fuel gas supplied to a fuel cell was a methanol, when this system was carried in an automobile, there was nonconformity which cannot supply with oil in the usual gas station. Moreover, in the above-mentioned conventional fuel cell generation-of-electrical-energy system, since the operating temperature of a fuel cell was comparatively low, when a fuel cell was not supplied after reforming a methanol thoroughly to H2 (hydrogen gas) with a refining vessel, there was a trouble that the generation efficiency of a fuel cell fell. Furthermore, in the above-mentioned conventional fuel cell generation-of-electrical-energy system, since the electrolyte layer was formed of the macromolecule membrane system, there was a possibility that CO (carbon monoxide) might be discharged from a generation-of-electrical-energy cel, and there was also a trouble that processing of this carbon monoxide was troublesome.
[0005] The 1st object of this invention is to offer the hybrid power system which can use the usual gasoline which can be refueled in a gas station, gas oil, etc. as a raw material of the fuel gas supplied to a fuel cell module. Since the 2nd object of this invention has the comparatively high operating temperature of a fuel cell,

even if it supplies CO and CH4 other than H2 (methane) to a direct fuel cell, a fuel cell module is to offer the hybrid power system which can be generated efficiently. Since the 3rd object of this invention has the comparatively high operating temperature of a fuel cell, it is by using the waste heat of an engine or a fuel cell to offer the hybrid power system which can reform hydrocarbons, such as a gasoline and gas oil, promptly to a low hydrocarbon, CO, or H2.

[0006]

[Means for Solving the Problem] The engine 11 with which invention concerning claim 1 generates mechanical power in combustion of the gaseous mixture of the fuel gas which evaporated the hydrocarbon as shown in drawing 1 and drawing 2 , and air, By supplying the fuel gas with which two or more laminatings of the generation-of-electrical-energy cel 24 which consists of the fuel electrode layer 31 and air electrode layer 32 which were arranged in both sides of the solid electrolyte layer 29 and this solid electrolyte layer 29 were carried out, and it reformed the above-mentioned hydrocarbon to the fuel electrode layer 31, and supplying the above-mentioned air or oxygen to an air electrode layer 32 It is the hybrid power system equipped with the fuel cell module 13 which can be generated below 930 degrees C, and is characterized by being constituted so that either or the both sides of power which the mechanical power which an engine 11 generates, or the fuel cell module 13 generates may be outputted.

[0007] In the hybrid power system indicated by this claim 1, if an engine 11 is put into operation, an engine 11 will generate mechanical power. Moreover, if the temperature which can generate the fuel cell module 13 is reached, the fuel gas which reformed the hydrocarbon is supplied to the fuel cell module 13 with air or oxygen, and the fuel cell module 13 will start a generation of electrical energy, and will generate power. At a certain time, the power which the fuel cell module 13 generates comes out enough, an engine 11 is suspended, when the power which the fuel cell module 13 generates is insufficient, an engine 11 is put into operation and the mechanical power which an engine 11 generates is outputted.

[0008] Invention concerning claim 2 is invention concerning claim 1, and as further shown in drawing 1 , it is characterized by having heated the fuel cell module 13 and being constituted possible [starting] by the exhaust gas discharged from the engine 11. In the hybrid power system indicated by this claim 2, since the fuel cell module 13 is heated by the heat of the exhaust gas discharged from the engine 11 and it goes up to the temperature which can be started, the generation of electrical energy of the fuel cell module 13 is attained.

[0009] Invention concerning claim 3 is invention concerning claim 1 or 2, and as further shown in drawing 1 , it is characterized by being constituted so that the mechanical power which an engine 11 generates may be changed into power by the generator 12 and may be outputted. In the hybrid power system indicated by this claim 3, if an engine 11 is put into operation, a generator 12 will drive with an engine 11 and power will be generated. If the temperature which can generate the fuel cell module 13 is reached, the fuel gas which reformed the hydrocarbon is supplied to the fuel cell module 13 with air or oxygen, and the fuel cell module 13 will start a generation of electrical energy, and will generate power. The power which the fuel cell module 13 generates comes out enough, an engine 11 is suspended, and at a certain time, when the power which the fuel cell module 13 generates is insufficient, an engine 11 is put into operation, and the mechanical power which an engine 11 generates is changed into power with a generator 12, and is outputted.

[0010] invention concerning claim 4 -- claim 1 thru/or 3 -- it is invention concerning either, and as further shown in drawing 1 , it is characterized by having further the rechargeable battery 14 in which the power which either or the both sides of the fuel cell module 13 or a generator 12 generates is stored. In the hybrid power system indicated by this claim 4, the power stored in the rechargeable battery 14 when an output was insufficient is outputted, and when the power which the fuel cell module 13 or a generator 12 generates is in a complementary, the power which the fuel cell module 13 or a generator 12 generates is stored in a rechargeable battery 14.

[0011] invention concerning claim 5 -- claim 1 thru/or 4 -- it is invention concerning either, and as further shown in drawing 1 , one sort chosen from the group which consists of the fuel cell module 13, a generator 12, and a rechargeable battery 14, or two sorts or more of power to generate is outputted to an electrical machinery and apparatus 16, and it is characterized by being constituted so that this electrical machinery and apparatus 16 may drive with the above-mentioned power. In the hybrid power system indicated by this claim 5, if an engine 11 is put into operation, a generator 12 will drive with an engine 11, power will be generated, and this power

will be outputted to an electrical machinery and apparatus 16. If the temperature which can generate the fuel cell module 13 is reached, the fuel gas which reformed the hydrocarbon is supplied to the fuel cell module 13 with air or oxygen, the fuel cell module 13 will start a generation of electrical energy, and will generate power, and this power will be supplied to an electrical machinery and apparatus 16. The power outputted to an electrical machinery and apparatus 16 from the fuel cell module 13 comes out enough, and suspends an engine 11 at a certain time. Moreover, when the power outputted to an electrical machinery and apparatus 16 is insufficient, an engine 11 is put into operation, the mechanical power which an engine 11 generates is changed into power with a generator 12, and it outputs to an electrical machinery and apparatus 16. Moreover, it is desirable that the above-mentioned electrical machinery and apparatus 16 is an electric motor.

[0012] invention concerning claim 7 -- claim 1 thru/or 6 -- it is invention concerning either, and as further shown in drawing 1 and drawing 2 , it is characterized by being constituted so that refining of the fuel gas supplied to the generation-of-electrical-energy cel 24 may be carried out by the exhaust gas discharged from the engine 11. In the hybrid power system indicated by this claim 7, with the heat of the exhaust gas discharged from the engine 11, since it goes up to the temperature which can reform fuel gas before the generation-of-electrical-energy cel 24 is supplied, refining of the fuel gas is carried out and it becomes the optimal low hydrocarbon group for generating operation.

[0013] invention concerning claim 8 -- claim 1 thru/or 7, as it is invention concerning either and is further shown in drawing 1 and drawing 2 The fuel preheating tubing 61 for preheating fuel gas and supplying a fuel electrode layer 31 is formed in the fuel cell module 13. In order to preheat oxidizing agent gas and to supply the oxidizing agent electrode layer 32, the oxidizing agent preheating tubing 62 is formed in the fuel cell module 13. It is characterized by being constituted so that refining of the hydrocarbon containing the steam which the exhaust gas discharged from the engine 11 preheats the oxidizing agent preheating tubing 62, and the exhaust gas discharged from the engine 11 preheats the fuel preheating tubing 61, and passes along the inside of the fuel preheating tubing 61 may be carried out. In the hybrid power system indicated by this claim 8, since the generation-of-electrical-energy cel 24 is supplied after the fuel gas in the fuel preheating tubing 61 and the oxidizing agent gas in the oxidizing agent preheating tubing 62 are heated by the exhaust gas of an engine 11, the generation-of-electrical-energy cel 24 goes up to the optimal temperature promptly, and the generation of electrical energy of it is attained.

[0014] Invention concerning claim 9 is invention concerning claim 7 or 8, and as further shown in drawing 2 , it is characterized by filling up a refining particle with the consistency in which a hydrocarbon can circulate in the fuel preheating tubing 61. In the hybrid power system indicated by this claim 9, the fuel gas containing a steam contacts a refining particle within the fuel preheating tubing 61, and refining is carried out to a low hydrocarbon group's fuel gas etc., and it is supplied to the generation-of-electrical-energy cel 24.

[0015] invention concerning claim 10 -- claim 1 thru/or 9, as it is invention concerning either and is further shown in drawing 1 and drawing 2 The case 66 for refining where the refining machine 64 is formed in about 13 fuel cell module, and the exhaust gas of an engine 11 is introduced for the refining machine 64, It has the reformer tube 67 with which it held in the case 66 for refining, and the refining particle was filled up with the consistency in which brown coal-ized hydrogen can circulate. When a hydrocarbon passes a reformer tube 67, it is characterized by being constituted so that refining of the hydrocarbon may be carried out to a low hydrocarbon group's fuel gas, CO, or the fuel gas of H2 and it may be supplied to the fuel cell module 13. In the hybrid power system indicated by this claim 10, if a hydrocarbon flows into the reformer tube 67 of the refining machine 64 with water, this hydrocarbon and water will be heated with the exhaust gas which passes through the inside of the case 66 for refining, will be evaporated, and will become fuel gas containing a steam. The fuel gas containing this steam contacts a refining particle within a reformer tube 67, and refining is carried out to a low hydrocarbon group's fuel gas etc., and it is supplied to the fuel cell module 13. Moreover, since the refining machine 64 is formed in about 13 fuel module, the heat which the refining machine 64 generates from the fuel module 13 at the time of a generation of electrical energy is absorbed, and refining of the fuel gas containing a steam is carried out still more efficiently to a low hydrocarbon group's fuel gas etc. by the refining particle within a reformer tube 67.

[0016] Invention concerning claim 11 is invention concerning claim 10, and as further shown in drawing 2 , it is characterized by forming the 1st auxiliary heater 81 which heats the reformer tube 67 in the refining machine

64. In the hybrid power system indicated by this claim 11, if a hydrocarbon flows into the reformer tube 67 of the refining machine 64 with water, since this hydrocarbon and water will be heated not only by the exhaust gas of the engine 11 which passes through the inside of the case 66 for refining but by the 1st auxiliary heater 81, it becomes fuel gas which evaporates promptly and contains a steam. The fuel gas containing this steam contacts a refining particle within a reformer tube 67, and refining is promptly carried out to a low hydrocarbon group's fuel gas, CO, or the fuel gas of H2.

[0017] invention concerning claim 12 -- claim 7 thru/or 11 -- it is invention concerning either, and as further shown in drawing 2 , it is characterized by forming the 2nd auxiliary heater 82 which heats the fuel preheating tubing 61 and the oxidizer preheating tubing 62 in the fuel cell module 13. In the hybrid power system indicated by this claim 12 If a low hydrocarbon group's fuel gas, CO, or the fuel gas of H2 flows into the fuel preheating tubing 61 in the fuel cell module 13 and oxidant gas flows into the oxidizer preheating tubing 62 Fuel gas and oxidizing agent gas are heated not only by the exhaust gas of the engine 11 which passes through the inside of the fuel cell module 13 but by the 2nd auxiliary heater 82, and after [for a generation of electrical energy / optimal] being comparatively heated by the elevated temperature, they are supplied to the generation-of-electrical-energy cel 24.

[0018] invention concerning claim 13 -- claim 7 thru/or 12 -- it is invention concerning either, and as further shown in drawing 1 and drawing 2 , it is characterized by forming the fuel injector 73 which a fuel feed pipe 68 is connected to the end face of the fuel preheating tubing 61, injects the high-melting hydrocarbon which is a liquid in ordinary temperature among hydrocarbons in the shape of a fog, and is supplied to the fuel preheating tubing 61 in a fuel feed pipe 68. Invention concerning claim 14 is invention concerning claim 13, and as further shown in drawing 1 and drawing 2 , it is characterized by forming the water-injection machine 76 which the water delivery pipe 74 is connected to a fuel feed pipe 68, injects water in the shape of a fog, and is supplied to a fuel feed pipe 73 in the water delivery pipe 73. In the hybrid power system indicated by these claims 13 or 14, the fuel or water of a liquid is promptly vaporizable.

[0019] invention concerning claim 15 -- claim 1 thru/or 14, as it is invention concerning either and is further shown in drawing 1 The module temperature sensor 72 which detects the temperature of this fuel cell module 13 is inserted in the fuel cell module 13. When the module temperature sensor 72 detects that the fuel cell module 13 was heated by the exhaust gas of an engine 11, and reached the temperature which can generate the fuel module 13 It is characterized by being constituted so that it may be alike, a controller 77 may control the fuel cell module 13 and generating operation may be started. In the hybrid power system indicated by this claim 15 When the fuel cell module 13 is low temperature like [immediately after engine 11 start up] If a temperature sensor 72 detects having maintained at the condition of having suspended the generation of electrical energy by the fuel cell module 13, and the fuel cell module 13 having been heated by the exhaust gas of an engine 11, and having reached the temperature which can be generated Since the generation of electrical energy by the fuel cell module 72 is made to start, the generation of electrical energy with the sufficient effectiveness by the fuel cell module 13 is attained.

[0020] Moreover, it is desirable to be constituted so that one sort chosen from the group which a controller 77 becomes from an engine 11, the fuel cell module 13, and a rechargeable battery 14 based on the load of an electrical machinery and apparatus 16, or two sorts or more may be controlled. Moreover, the oxidizer flow control valve 71 can be formed in the oxidizer delivery pipe 69 prepared in the end face of the oxidizer preheating tubing 62, and a refining machine temperature sensor can detect the temperature of the refining machine 64, and it can constitute so that a controller 77 may control a fuel injector 73, the water-injection machine 76, the oxidizer flow control valve 71, the 1st auxiliary heater 81, and the 2nd auxiliary heater 82 based on each detection output of the module temperature sensor 72 and a refining machine temperature sensor.

[0021] Moreover, the 1st motor bulb 91 which opens and closes 63f of this communicating tube to 63f of communicating tubes which open for free passage 63d of inner side houses of the cell case 63 and outside room 63e which hold the fuel cell module 13 is formed. The 2nd motor bulb 92 which opens and closes this upstream exhaust pipe 21a is formed in upstream exhaust pipe 21a which opens an engine 11 and the fuel cell module 13 for free passage. The 3rd motor bulb 93 which opens and closes this upstream branch-pipe 21c is formed in upstream branch-pipe 21c which opens upstream exhaust pipe 21a and the refining machine 64 for free passage. It can also be constituted so that a controller 77 may control the 1st - the 3rd motor bulbs 91-93 based on each

detection output of the module temperature sensor 72 and a refining machine temperature sensor. In addition, it is desirable to be constituted so that an automobile, a ship, an electric car, an airplane, a motorcycle, or a construction equipment may drive with either or the both sides of mechanical power which an electrical machinery and apparatus 16 or an engine 11 generates.

[0022]

[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained based on a drawing. As shown in drawing 1 , the hybrid power system of this invention is carried in an automobile. This hybrid power system is equipped with the engine 11 which uses a gasoline as a fuel, the generator 12 with which input-shaft 12a was connected with crankshaft 11a of this engine 11, the fuel cell module 13 which can be generated below 930 degrees C, a rechargeable battery 14, and an electric motor 16. An inlet pipe 18 is connected to the inlet port of an engine 11 through an inlet manifold 17, and upstream exhaust pipe 21a of an exhaust pipe 21 is connected to the exhaust port of an engine 11 through an exhaust manifold 19. The carburetor 22 which is made to evaporate a gasoline in the middle of an inlet pipe 18, and is supplied to an inlet pipe 18 is formed, and the head of a feed pipe 23 where the end face was connected to the fuel tank (a gasoline is stored.) is connected to this carburetor 22. It is mixed with air and the gasoline evaporated with the carburetor 22 is supplied to the cylinder (not shown) of an engine 11 through an inlet pipe 18 and an inlet manifold 17, and by burning explosively within this cylinder and driving a piston (not shown), it is constituted so that crankshaft 11a may be rotated. Moreover, by transmitting the turning effort of the above-mentioned crankshaft 11a to input-shaft 12a, a generator 12 is constituted so that power may be generated. In addition, this invention is applicable also to the rotary engine which has Rota of the triangle instead of the recipro engine which has cylinder-like a piston and a crankshaft, and an eccentric shaft.

[0023] As for the fuel cell module 13, it is desirable for it to be able to generate electricity in 300-900 degrees C, and as shown in drawing 2 , it is equipped with the fuel cell 26 which has the generation-of-electrical-energy cel 24 of the individual (n+1) by which the laminating was carried out, and the distributor 27 for fuels and the distributor 28 for air formed near this fuel cell 26, respectively. Here, n is a forward integer. The generation-of-electrical-energy cel 24 consists of a disc-like solid electrolyte layer 29, and the disc-like fuel electrode layer 31 and disc-like air electrode layer 32 which were arranged in both sides of this solid electrolyte layer 29. Between the air electrode layers 32 of the generation-of-electrical-energy cel 24 of eye watch (i+1) adjoin the fuel electrode layer 31 and this fuel electrode layer 31 of the i-th generation-of-electrical-energy cel (i= 1, 2, --, n) 24, a total of every one separators [n] 33 formed in square tabular with the conductive ingredient is infixed, respectively. Moreover, the air pole charge collector 36 of the porosity which the fuel electrode charge collector 34 of the porosity which is formed disc-like between the fuel electrode layer 31 of the i-th generation-of-electrical-energy cel 24 and the j-th separator (j= 1, 2, --, n) 33, and has conductivity is infixed, and is formed disc-like between the air electrode layer 32 of the generation-of-electrical-energy cel 24 of eye watch (i+1) and the j-th separator 33, and has conductivity is infixed. The laminating of the 1st single end plate 41 formed in square tabular with the conductive ingredient through the air pole charge collector 36 is carried out to the air electrode layer 32 of the 1st [further] generation-of-electrical-energy cel 24, and the laminating of the 2nd single end plate 42 formed in square tabular with the conductive ingredient through the fuel electrode charge collector 34 is carried out to the fuel electrode layer 31 of the generation-of-electrical-energy cel 24 of eye watch (n+1). In addition, a solid electrolyte layer, a fuel electrode layer, an air electrode layer, a fuel electrode charge collector, and an air pole charge collector may be formed in polygon tabular, such as not disc-like but square tabular, hexagon tabular, and octagon tabular. Moreover, a separator, the 1st end plate, and the 2nd end plate may be formed in polygon tabular, such as not square tabular but disc-like or rectangular plate-like, hexagon tabular, and octagon tabular.

[0024] The solid electrolyte layer 29 is formed by the oxide ion conductor. Specifically, it is the oxide ion conductor shown by general formula (1):Ln1 A Ga B1 B-2 B3 O. However, in the above-mentioned general formula (1), Ln(s)1 are one sort or two sorts or more of elements chosen from the group which consists of La, Ce, Pr, Nd, and Sm, and are contained 43.6 to 51.2% of the weight. A is one sort or two sorts or more of elements chosen from the group which consists of Sr, calcium, and Ba, and is contained 5.4 to 11.1% of the weight. Ga is contained 20.0 to 23.9% of the weight, and B1 is one sort or two sorts or more of elements chosen from the group which consists of Mg, aluminum, and In. B-2s are one sort or two sorts or more of elements

chosen from the group which consists of Co, Fe, nickel, and Cu. When B3 is one sort or two sorts or more of elements chosen from the group which consists of aluminum, Mg, Co, nickel, Fe, Cu, Zn, Mn, and Zr and B1, B3, or B-2 and B3 is not the respectively same element, When B1 is contained 1.21 to 1.76% of the weight, B-2 is contained 0.84 to 1.26% of the weight, B3 is contained 0.23 to 3.08% of the weight and B1, B3, or B-2 and B3 is the respectively same element, The sum total of the content of B1 and the content of B3 is 1.41 - 2.70 % of the weight, and the sum total of the content of B-2 and the content of B3 is 1.07 - 2.10 % of the weight.
[0025] Moreover, the solid electrolyte layer 29 may be formed with the oxide ion conductor shown by general formula (2):Ln11-x Ax Ga1-y-z-w B1y B-2z B3w O3-d. However, they are one sort or two sorts or more of elements chosen from the group which Ln1 becomes from La, Ce, Pr, Nd, and Sm in the above-mentioned general formula (2). A is one sort or two sorts or more of elements chosen from the group which consists of Sr, calcium, and Ba. B1 is one sort or two sorts or more of elements chosen from the group which consists of Mg, aluminum, and In. B-2s are one sort or two sorts or more of elements chosen from the group which consists of Co, Fe, nickel, and Cu. B3 is one sort or two sorts or more of elements chosen from the group which consists of aluminum, Mg, Co, nickel, Fe, Cu, Zn, Mn, and Zr. For 0.025 to 0.29, and z, 0.01 to 0.15 and w are [x / 0.05 to 0.3, and y / 0.035-0.3, and d of 0.01 to 0.15 and y+z+w] 0.04-0.3. By forming the solid electrolyte layer 29 with the above oxide ion conductors, it becomes possible to perform generating operation at low temperature comparatively with 650**50 degrees C, without reducing the generation efficiency of a fuel cell 26.
[0026] A fuel electrode layer 31 is constituted by metals, such as nickel, is constituted by cermets, such as nickel-YSZ, or is formed in porosity of a mixture with the compound expressed with nickel and general formula (3):Ce1-m Dm O2. however, one sort or two sorts or more of elements chosen from the group which D becomes from Sm, Gd, Y, and calcium in the above-mentioned general formula (3) -- it is -- m -- the atomic ratio of D element -- it is -- 0.05 to 0.4 -- it is preferably set as the range of 0.1-0.3.
[0027] An air electrode layer 32 is formed in porosity by the oxide ion conductor shown by general formula (4):Ln21-x Ln3x E1-y Coy O3+d. However, in the above-mentioned general formula (4), Ln2 is the element of either La or Sm and both sides, Ln3 is the element of either Ba, calcium or Sr and both sides, and E is the element of either Fe or Cu and both sides. Moreover, x is the atomic ratio of Ln3, exceeds 0.5 and is set as less than 1.0 range. y is the atomic ratio of Co element, exceeds 0 and is preferably set as or more 0.5 1.0 or less range 1.0 or less. d is set as or more -0.5 0.5 or less range.
[0028] An example of the manufacture approach of the above-mentioned generation-of-electrical-energy cel 24 is shown below. First, as raw material powder, after carrying out weighing capacity and mixing each powder of La 2O3, SrCO3 and Ga 2O3, and MgO and CoO so that it may be set to La0.8Sr0.2Ga0.8Mg0.15Co 0.05O2.8, preliminary baking is carried out at 1100 degrees C, and a temporary-quenching object is produced. Subsequently, after pulverizing this temporary-quenching object, by adding a predetermined binder, a solvent, etc. and mixing, a slurry is prepared and a green sheet is produced for this slurry by the doctor blade method. Next, after fully drying this green sheet in air and starting in a predetermined dimension, the solid electrolyte layer 29 is obtained by sintering at 1450 degrees C. After mixing NiO powder and O(Ce0.8Sm0.2)2 powder to one field of this solid electrolyte layer 29 so that nickel and O (Ce0.8Sm0.2)2 may be set to 6:4 by the volume ratio, a fuel electrode layer 31 is formed in it by baking this mixed powder at 1100 degrees C. Furthermore, an air electrode layer 32 is formed by baking CoO(Sm0.5Sr0.5) 3 on the field of another side of the above-mentioned solid electrolyte layer 29 at 1000 degrees C. Thus, the generation-of-electrical-energy cel 24 is produced.
[0029] As for a separator 33, it is desirable to be formed with stainless steel, a nickel radical alloy, or a chromium radical alloy. For example, SUS316, Inconel 600, Hastelloy X (trade name of Haynes Stellite), the HEINZU alloy 214, etc. are mentioned. Moreover, the fuel-supply path 43, the air supply path 44 (oxidizer supply path), and two or more insertion hole 33a are formed in a separator 33 (drawing 3 and drawing 4). The fuel-supply path 43 has 2nd fuel hole 43b which opens for free passage from the peripheral face of a separator 33 focusing on abbreviation to 1st fuel hole of the other side 43a, and 1st fuel hole 43a, and attends the fuel electrode charge collector 34 from the abbreviation core of a separator 33. Moreover, single 1st air vent 44a to which the air supply path 44 was extended and formed in the direction which intersects perpendicularly in the thickness direction of a separator 33, and the end face carried out opening to separator 33 peripheral face, and the closedown of the head was carried out, Two or more 2nd air vent 44b to which it extended in the direction

which intersects perpendicularly in the thickness direction of a separator 33, and it was opened and formed, predetermined spacing was mutually opened for free passage to single 1st air vent 44a, and the closedown of the ends was carried out further, It has 3rd air vent 44c of a large number formed so that predetermined spacing might be opened in the field which counters the air pole charge collector 36 of a separator 33 and it might be open for free passage to 2nd air vent 44b.

[0030] After forming mutually two or more above-mentioned 2nd air vent 44b in parallel from the side face contiguous to one side face of a separator 33 in which the end face of 1st air vent 44a was formed, it becomes the slot to which the closedown of the ends was carried out by joining the closedown plate 45 to this adjoining side face. Two or more insertion hole 33a is formed in parallel at 1st fuel hole 43a and 2nd air vent 44b so that it may be open for free passage to neither the fuel-supply path 43 nor the air supply path 44, and the 1st heater 31 is inserted in such insertion hole 33a, respectively (drawing 4). Moreover, three slit 33b is formed in the field which counters the fuel electrode charge collector 34 of a separator 33 from the abbreviation core of a separator 33 at a curled form, respectively (drawing 5), and the depth of such slit 33b is formed so that it may become the same covering an overall length. In addition, the above-mentioned slit may be not three but 2, or 4 or more. Moreover, the depth of a slit may be formed so that it may become deeply or shallow gradually, as it separates from the core of a separator.

[0031] When it returns to drawing 3 , the fuel electrode charge collector 34 is formed in porosity with stainless steel, a nickel radical alloy, a chromium radical alloy or nickel, silver, a silver alloy, or copper and it forms with stainless steel, a nickel radical alloy, or a chromium radical alloy, it is desirable to give the silver plating or copper plating through nickel plating, silver plating, and nickel substrate plating. When it is formed in porosity with stainless steel, a nickel radical alloy, a chromium radical alloy or silver, a silver alloy, or platinum and forms with stainless steel, a nickel radical alloy, or a chromium radical alloy, as for the air pole charge collector 36, it is desirable to perform the silver plating or platinum plating through silver plating and nickel substrate plating. in addition, when the fuel gas of low hydrocarbon groups, such as CH4, is used as fuel gas by which refining was carried out When a fuel electrode charge collector is formed with the stainless steel by which nickel plating was carried out, a nickel radical alloy, a chromium radical alloy, or nickel and CO or H2 is used as fuel gas A fuel electrode charge collector is formed with the silver plating through silver plating and nickel substrate plating or the stainless steel by which copper plating was carried out, a nickel radical alloy, a chromium radical alloy or silver, a silver alloy, or copper. An example of the manufacture approach of the above-mentioned fuel electrode charge collector 34 is shown below. After kneading atomization powder and HPMC(s) (water-soluble-resin binder), such as stainless steel, first, distilled water and additives (n-hexane (organic solvent), DBS (surfactant), glycerol (plasticizer), etc.) are added and kneaded, and a mixed slurry is prepared. Next, this mixed slurry is foamed, degreased and sintered on condition that predetermined, after producing a Plastic solid by the doctor blade method, and a porosity plate is obtained. Furthermore, this porosity plate is cut down in a predetermined dimension, and the fuel electrode charge collector 34 is produced. In addition, when the atomization powder of stainless steel is used, nickel plating, chrome plating, or silver plating is performed to a front face. Moreover, the above-mentioned air pole charge collector 36 as well as [almost] the above-mentioned fuel electrode charge collector 34 is produced.

[0032] The 1st end plate 41 and the 2nd end plate 42 are formed in the same configuration (square tabular) with the same ingredient as a separator 33. The air supply path 48 and two or more insertion holes (not shown) are formed in the 1st end plate 41, and the fuel-supply path 47 and two or more insertion holes (not shown) are formed in the 2nd end plate 42. The 1st single air vent to which the air supply path 48 was formed like the air supply path 43, it was extended and formed in the direction which intersects perpendicularly in the thickness direction of the 1st end plate 41, and the end face carried out opening to 1st end plate 41 peripheral face, and the closedown of the head was carried out (not shown), Two or more 2nd air vent 48b to which it extended in the direction which intersects perpendicularly in the thickness direction of the 1st end plate 41, and it was opened and formed, predetermined spacing was mutually opened for free passage to the 1st single air vent, and the closedown of the ends was carried out further, It has the 3rd air vent (not shown) of a large number formed so that predetermined spacing might be opened in the field which counters the air pole charge collector 36 of the 1st end plate 41 and it might be open for free passage to 2nd air vent 48b. Moreover, the fuel-supply path 47 is formed like the fuel-supply path 43, and has 2nd fuel hole 47b which opens for free passage from the peripheral

face of the 2nd end plate 42 focusing on abbreviation to 1st fuel hole of the other side 47a, and 1st fuel hole 47a, and attends the fuel electrode charge collector 34 from the abbreviation core of the 2nd end plate 42.
[0033] After forming mutually in parallel two or more 2nd air vent 48b formed in the 1st end plate 41 from the side face contiguous to one side face of the 1st end plate 41 in which the end face of the 1st air vent was formed, it becomes the slot to which the closedown of the ends was carried out by joining the closedown plate 45 to this adjoining side face. Moreover, two or more insertion holes of the 1st end plate 41 are formed in parallel at 2nd air vent 48b so that it may not be open for free passage to the air supply path 48, and a heater (not shown) is inserted in these insertion holes, respectively. Two or more insertion holes of the 2nd end plate 42 are formed in parallel at 1st fuel hole 47a so that it may not be open for free passage to the fuel-supply path 47, and a heater (not shown) is inserted in these insertion holes, respectively. Three slit 42b is formed in the top face of the 2nd end plate 42, i.e., the opposed face to the fuel electrode charge collector 46 of the 2nd end plate 42, from the abbreviation core of the 2nd end plate 22 at a curled form (drawing 3). The depth of such slit 42b is formed so that it may become the same covering an overall length. In addition, the above-mentioned slit may be not three but 2, or 4 or more. Moreover, the depth of a slit may be formed so that it may become deeply or shallow gradually, as it separates from the core of a separator.
[0034] Furthermore, through-hole 33c which can insert in a bolt (not shown) is formed in the four corners of a separator 33, the 1st end plate 41, and the 2nd end plate 42 (drawing 4 and drawing 5). (n+1) When the laminating of the generation-of-electrical-energy cel 24 of an individual, the separator 33 of n sheets, the fuel electrode charge collector 34 of an individual (n+1), the air pole charge collector 36 of an individual (n+1), the 1st single end plate 41, and the 2nd single end plate 42 is carried out After inserting a bolt in through-hole 33c formed in the four corners of the above-mentioned separator 33, the 1st end plate 41, and the 2nd end plate 42, respectively, a fuel cell 26 is fixed by screwing a nut at the head of these bolts, respectively, where a laminating is carried out [above-mentioned].
[0035] It returns to drawing 2 , and the distributor 27 for fuels and the distributor 28 for air are prolonged in the direction of a laminating of the generation-of-electrical-energy cel 24, are formed, respectively, and are formed in tubed [to which the closedown of the ends was carried out]. Free passage connection of the distributor 27 for fuels is made through the short pipe 51 for fuels of a book (n+1) at 1st fuel hole 43a of the fuel-supply path 43 of the separator 33 of n sheets, and 1st fuel hole 47a of the fuel-supply path 47 of the 2nd single end plate 42, respectively. Free passage connection of the distributor 28 for air is made through the short pipe 52 for air of a book (n+1) at the 1st air vent (not shown) of 1st air vent 44a of the air supply path 44 of the separator 33 of n sheets, and the air supply path 48 of the 1st single end plate 41, respectively. With the gestalt of this operation, the distributor 27 for fuels, the distributor 28 for air, the short pipe 51 for fuels, and the short pipe 52 for air are formed with conductive ingredients, such as stainless steel.
[0036] Between the short pipe 51 for fuels, and the distributor 27 for fuels, in order to secure the electric insulation with the short pipe 51 for fuels, and the distributor 27 for fuels, the insulating tube for fuels (not shown) formed with electric insulation ingredients, such as an alumina, is infixed, and these clearances are closed by closure members for fuels (not shown), such as glass. Moreover, between the short pipe 52 for air, and the distributor 28 for air, in order to secure the electric insulation with the short pipe 52 for air, and the distributor 28 for air, the insulating tube for air (not shown) formed with electric insulation ingredients, such as an alumina, is infixed, and these clearances are closed by closure members for air (not shown), such as glass.
[0037] The electrode terminals 58 and 58 (the gestalt of this operation electrode) of a couple are electrically connected in the center of a top face of the 1st end plate 41, and the center of an underside of the 2nd end plate 42, respectively. The fuel preheating tubing 61 is connected to the up peripheral face of the distributor 27 for fuels, and this fuel preheating tubing 61 opens predetermined spacing from the peripheral face of a fuel cell 26, and it is wound in the shape of [centering on the axis of the electrode terminals 58 and 58 of a couple] a spiral. Moreover, the air preheating tubing 62 is connected to the up peripheral face of the distributor 28 for air, and this air preheating tubing 62 opens predetermined spacing from the peripheral face of a fuel cell 26, and it is wound in the shape of [centering on the axis of the electrode terminals 58 and 58 of a couple] a spiral. The spiral radius of the above-mentioned fuel preheating tubing 61 is formed smaller than the spiral radius of the above-mentioned air preheating tubing 62.
[0038] The above-mentioned fuel cell 26 is held in the cell case 63 with the distributor 27 for fuels, the

distributor 28 for air, the fuel preheating tubing 61, and the air preheating tubing 62. A fuel cell 26, the distributor 27 for fuels and the distributor 28 for air, and the fuel preheating tubing 61 and the air preheating tubing 62 are divided by 63d of inner side houses, and outside room 63e by cylinder-like diaphragm 63c. 63d of this inner side house and outside room 63e are opened for free passage by 63f of communicating tubes. Moreover, exhaust gas inlet 63a for introducing the exhaust gas of an engine 11 in this case 63 is formed in the peripheral face upper part of the cell case 63, and exhaust gas exhaust port 63b for discharging the exhaust gas introduced into this case 63 out of a case 63 with the fuel gas and air which were discharged from the fuel cell 26 is formed in the peripheral face lower part of the cell case 63. Upstream exhaust pipe 21a is connected to above-mentioned exhaust gas inlet 63a, and downstream exhaust pipe 21b is connected to above-mentioned exhaust gas exhaust port 63b. Moreover, the refining machine 64 is formed in the peripheral face of the cell case 63. This refining machine 64 has the reformer tube 67 which is held in the case 66 for refining where the exhaust gas of an engine 11 is introduced, and the case 66 for refining, and is heated by the exhaust gas of an engine 11. Exhaust gas inlet-port 66a which introduces the exhaust gas of an engine 11, and exhaust gas outlet 66b which discharges the exhaust gas of an engine 11 are prepared in the case 66 for refining. Upstream branch pipe 21c which branched from upstream exhaust pipe 21a is connected to above-mentioned exhaust gas inlet-port 66a, and 21d of downstream branch pipes is connected to above-mentioned exhaust gas outlet 66b. Moreover, the gasoline delivery pipe 68 which branched from the feed pipe 23 is connected to the end face of the fuel preheating tubing 51 through a reformer tube 67. Furthermore, a refining particle (not shown) is filled up into the above-mentioned reformer tube 67 with the consistency in which the fuel gas of the low hydrocarbon group of a gasoline, gas oil, and CH4 grade can circulate. This refining particle nickel, NiO, aluminum 2O3, SiO2, MgO, CaO, Fe 2O3, Fe3O4, V2O3, NiAl 2O4, ZrO2, SiC, It is desirable to be formed with the element or oxide containing one sort chosen from the group which consists of Cr 2O3, ThO2 and Ce 2O3, and B-2s O3, MnO2, ZnO, Cu, BaO, and TiO2, or two sorts or more.

[0039] The sign 69 of drawing 1 and drawing 2 is a pneumatic supply pipe for connecting with the end face of the air preheating tubing 52 within the cell case 63, and supplying air (oxygen being sufficient.) to the air preheating tubing 52, and a mass air flow control valve 71 is formed in this pipe 69 (drawing 1). The module temperature sensor 72 which detects the temperature of this fuel cell module 13 is inserted in the fuel cell module 13 (drawing 1 and drawing 2), and the gasoline injector 73 is formed in the gasoline delivery pipe 68 (drawing 1). Moreover, the water delivery pipe 74 is connected to the gasoline delivery pipe 68 of the downstream of the gasoline injector 73, and the water-injection machine 76 is formed in this water delivery pipe 74. The gasoline injector 73 is constituted so that the high-melting hydrocarbons (gas oil etc.) which is a liquid may be injected in the shape of a fog in ordinary temperature and a reformer tube 67 may be supplied, and the water-injection machine 76 is constituted so that water may be injected in the shape of a fog and the gasoline delivery pipe 68 may be supplied.

[0040] The 1st auxiliary heater 81 for heating a reformer tube 67 in the refining vessel 64 is formed, and the 2nd auxiliary heater 82 for heating the fuel preheating tubing 61 and the air preheating tubing 62 in outside room 63e is formed in the cell case 63. Moreover, the refining machine temperature sensor (not shown) which detects the temperature of this refining machine 64 in the refining vessel 64 is formed. The 1st auxiliary heater 81 has 1st case 81a attached in the underside of the case 66 for refining, and 1st burner 81b inserted in this 1st case 81a. The 2nd auxiliary heater 82 has 2nd case 82a attached in the underside of the cell case 63, and 2nd burner 82b inserted in this 2nd case 82a. It is constituted by the 1st and 2nd burners 81b and 82b so that gas oil may be supplied. Furthermore, the 1st - the 3rd motor bulbs 91-93 are formed in upstream exhaust pipe 21a, upstream branch-pipe 21c, and 63f of communicating tubes, respectively. The 1st - the 3rd motor bulbs 91-93 have the valve bodies 91a-93a which open and close the above-mentioned tubing 21a, 21c, and 63f, and the 1st which drives these valve bodies 91a-93a - the 3rd motor 91b and 93b.

[0041] Each detection output of the above-mentioned module temperature sensor 72 and a refining machine temperature sensor is connected to the control input of a controller 77, respectively, and the control output of a controller 77 is connected to a mass air flow control valve 71, the gasoline injector 73, the water-injection machine 76, the power supply-and-demand change-over machine 78, a heater 46, the 1st auxiliary heater 81, the 2nd auxiliary heater 82, the 1st - the 3rd motor 91b-93b, and a carburetor 22, respectively. A generator 12, the fuel cell module 13, a rechargeable battery 14, and an electric motor 16 are electrically connected to the power

supply-and-demand change-over machine 78, respectively. Moreover, the engine automatic turning-on-and-off equipment (not shown) which puts into operation or suspends this engine 11 automatically is formed in an engine 11, and this equipment is connected to a controller 77 at a control output. Furthermore, it is constituted so that the power supplied with the power supply-and-demand change-over vessel 78 from either or the both sides of a generator 12 and the fuel cell module 13 may be stored in a rechargeable battery 14, and it is constituted by the electric motor 16 so that power may be supplied from one sort chosen from the group which consists of a generator 12, a fuel cell module 13, and a rechargeable battery 14 with the power supply-and-demand change-over vessel 78, or two sorts or more. In addition, the sign 79 of drawing 2 is an insulating ring for insulating the cell case 63 from the electrode terminals 58 and 58 of a couple electrically.

[0042] Thus, actuation of the constituted hybrid power system is explained. If an engine 11 is put into operation, an engine 11 generates mechanical power, by transmitting this mechanical power to input-shaft 12a of a generator 12 from crankshaft 11a, a generator 12 will drive and power will be generated. Since the temperature (for example, 650 degrees C) which can generate the temperature of the fuel cell module 13 is not reached immediately after engine 11 start up A controller 77 is based on each detection output of the module temperature sensor 72 and a refining machine temperature sensor (not shown). It maintains at the condition of having closed the gasoline injector 73, the water-injection machine 76, and the 1st motor bulb 91. The power stored in the power and the rechargeable battery 14 which maintain at the condition of having opened the mass air flow control valve 71, the 2nd motor bulb 92, and the 3rd motor bulb 93, control the power supply-and-demand change-over machine 78 further, and are generated with a generator 12 is supplied to an electric motor 16, and it is made to run an automobile. Here, air is passed from immediately after engine 11 start up to the fuel cell module 13, being able to heat also from the inside of a fuel cell 26 and maintaining the temperature of a fuel cell 26 at homogeneity, since the air heated with the air preheating tubing 62 blows off from a separator 33 and the 2nd end plate 42 to homogeneity all over generation-of-electrical-energy cel 24, because it can heat promptly. Furthermore, when the generating operation of the rapid fuel cell module 13 is required, it energizes at a heater 46.

[0043] On the other hand, start up of an engine 11 discharges hot exhaust gas from an engine 11. The abbreviation one half of this exhaust gas is supplied to outside room 63e within the cell case 63 through an exhaust manifold 19 and upstream exhaust pipe 21a, and the remaining one half is supplied in the case 66 for refining through upstream branch pipe 21c which branches from upstream exhaust pipe 21a. If the module temperature sensor 72 detects the fuel cell 26 within the cell case 63 having been heated at the exhaust gas of an engine 11 or the exhaust gas of an engine 11, and a heater 46, and having reached the temperature which can be generated, a controller 77 will stop the energization to a heater 46 based on the detection output of this module temperature sensor 72, when energizing the gasoline injector 73, the water-injection machine 76, and the 1st motor bulb 91 at the aperture and the heater 46 by the predetermined opening, respectively. If the gasoline injector 73 and the water-injection machine 76 are opened, it flows into the reformer tube 67 of the refining machine 64, and a gasoline and water will be heated by the exhaust gas which passes through the inside of the case 66 for refining, will evaporate, and will become fuel gas containing a steam.

[0044] The fuel gas containing this steam contacts a refining particle within a reformer tube 67, and refining is carried out to a low hydrocarbon group, and it flows into the fuel preheating tubing 61 within the cell case 63. After this fuel gas by which refining was carried out is further heated by carrying out heat exchange of the peripheral face of a fuel cell 26 to hot exhaust gas with the surroundings spirally within the fuel preheating tubing 61, it is supplied to the distributor 27 for fuels. After the air which flowed into the air preheating tubing 62 from the pneumatic supply pipe 69 is heated by carrying out heat exchange of the peripheral face of a fuel cell 26 to hot exhaust gas with the surroundings spirally within the air preheating tubing 62, it is supplied to the distributor 28 for air. In addition, when taking much time amount to reach the temperature which the fuel cell 26 within the cell case 63 can generate only with heating at the exhaust gas and the heater 46 of an engine 11, a controller 77 operates the 1st and 2nd auxiliary heaters 81 and 82.

[0045] If the fuel gas by which was heated by the optimal temperature for a generation of electrical energy, and refining was carried out to it is introduced into the distributor 27 for fuels, this fuel gas will pass along the short pipe 51 for fuels, and the fuel-supply paths 43 and 47, and they will carry out the regurgitation toward the core of the fuel electrode charge collector 34 from the abbreviation core of a separator 33 and the 2nd end plate 42.

Thereby, fuel gas passes the pore in the fuel electrode charge collector 34, is promptly supplied focusing on the abbreviation for a fuel electrode layer 31, is further guided by slit 33b of a separator 33, and slit 42b of the 2nd end plate 42, and flows from the abbreviation core of a fuel electrode layer 31 to a curled form toward a periphery edge. If the air simultaneously heated by the optimal temperature for a generation of electrical energy is introduced into the distributor 28 for air, this air will pass along the short pipe 52 for air, and the air supply paths 44 and 48, and they will carry out the regurgitation to the shape of a shower toward the air pole charge collector 36 from many 3rd air vent (not shown) of much 3rd air vent 44c of a separator 33, and the 1st end plate 41. Thereby, air passes the pore in the air pole charge collector 36, and is supplied to an air electrode layer 32 at abbreviation homogeneity.

[0046] The air supplied to the air electrode layer 32 reaches near the interface with the solid electrolyte layer 29 through the pore in an air electrode layer 32, and the oxygen in air receives an electron from an air electrode layer 32 in this part, and it is ionized by oxide ion (O2-). If this oxide ion carries out spreading diffusion of the inside of the solid electrolyte layer 29 toward the direction of a fuel electrode layer 31 and reaches near the interface with a fuel electrode layer 31, it will react with fuel gas in this part, will produce a resultant (for example, H2O), and will emit an electron to a fuel electrode layer 31. By taking out this electron with the fuel electrode charge collector 34, a current occurs and power is obtained.

[0047] Since fuel gas is breathed out as mentioned above from the center of abbreviation of a separator 33, and the center of abbreviation of the 2nd end plate 42 and it shows around by Slits 33b and 42b, the reaction path of fuel gas becomes long. Consequently, since fuel gas will collide with a fuel electrode layer 31 very mostly by the time fuel gas arrives at the periphery edge of a separator 33 and the 2nd end plate 42, the above-mentioned count of a reaction can increase and improvement in the engine performance of a fuel cell 26 can be aimed at. Therefore, the more the outer diameter of a separator 33 and the 2nd end plate 42 becomes large, the reaction path of fuel gas becomes long, the count of a reaction increases in connection with this, and, the more it leads to the improvement in an output of a fuel cell 26. In addition, since it connects with a serial through the separator 33, the fuel electrode charge collector 34, and the air pole charge collector 36 which were formed with the conductive ingredient and the electrode terminals 58 and 58 of a couple are formed in the 1st end plate 41 and the 2nd end plate 42 of ends of a fuel cell 26, the generation-of-electrical-energy cel 24 of an individual (n+1) can take out big power from these electrode terminals 58 and 58.

[0048] Moreover, since hot fuel gas is discharged from the peripheral face of a fuel electrode layer 31 and hot air is discharged from the peripheral face of an air electrode layer 32, these mixed gas flows into outside room 63e through 63f of communicating tubes, and the air in the fuel gas in the fuel preheating tubing 61 and the air preheating tubing 62 is heated. Consequently, after a fuel cell 26 starts a generation of electrical energy, after predetermined time progress, a controller 77 closes the 2nd motor bulb 91, and suspends installation of the exhaust gas of the engine 11 into the cell case 63. On the other hand, by controlling a carburetor, a controller 77 suspends supply of the gasoline to an inlet pipe 18, and stops an engine 11 while it will control the power supply-and-demand change-over machine 78 and will supply the power from the fuel cell module 13 to an electric motor 16, if the fuel cell module 13 generates power. Moreover, when the output of an electric motor 16 is insufficient, or when the charges of a rechargeable battery 14 are insufficient, a controller 77 puts an engine 11 into operation, and supplies power to an electric motor 16 or a rechargeable battery 14 from a generator 12.

[0049] In addition, although the solid electrolyte layer was formed with the gestalt of the above-mentioned implementation with the oxide ion conductor shown by general formula (1):Ln1 A GaB1 B-2 B3 O or general formula (2):Ln11-x Ax Ga1-y-z-w B1y B-2z B3w O3-d You may form with the oxide ion conductor which consists of YSZ (fully stabilized zirconia which added yttria), or may form with proton conductors (Seria system etc.). Moreover, although the electric motor was mentioned as an electrical machinery and apparatus with the gestalt of the above-mentioned implementation, electrical machinery and apparatus, such as a computer, a lamp (floodlight), and an electric heater, are sufficient.

[0050] Moreover, although it was made to run an automobile with the gestalt of the above-mentioned implementation with the mechanical power which changes into power with a generator the mechanical power which an engine generates, and drives an electric motor with either or the both sides of power which this power or a fuel cell module generates, and this electric motor generates, a ship, an electric car, an airplane (propeller type), a motorcycle, or a construction equipment may be driven. Moreover, the 1st clutch may be connected to

an engine crankshaft, the 2nd clutch may be connected to the output shaft of the electric motor driven with the power which a fuel cell module generates, and an automobile, a ship, an electric car, an airplane (propeller type), a motorcycle, or a construction equipment may be driven with either or the both sides of mechanical power which an electric motor or an engine generates.

[0051] Moreover, with the gestalt of the above-mentioned implementation, although the gasoline was supplied to the engine and the refining machine, gas oil or a propane may be supplied. Moreover, although the refining particle was filled up into the reformer tube of a refining machine with the consistency in which a gasoline etc. can circulate and the gasoline etc. was reformed to a low hydrocarbon group's fuel gas etc. by this refining particle with the gestalt of the above-mentioned implementation, a refining machine will become unnecessary, if a refining particle fills up with the consistency in which a gasoline etc. can circulate in fuel preheating tubing and a gasoline etc. can be reformed to a low hydrocarbon group's fuel gas etc. by this refining particle. Furthermore, with the gestalt of the above-mentioned implementation, although the separator was formed with stainless steel, the nickel radical alloy, or the chromium radical alloy, you may form by the ceramic which has conductivity, such as lanthanum chromite (La0.9Sr0.1CrO3).

[0052]

[Effect of the Invention] As stated above, according to this invention, power is generated in combustion of the gaseous mixture of the fuel gas which evaporated the hydrocarbon, and air. It generates electricity below 930 degrees C by supplying the fuel gas which reformed the above-mentioned hydrocarbon to the fuel electrode layer of the fuel cell module which carried out two or more laminatings of the generation-of-electrical-energy cel which consists of a solid electrolyte layer, a fuel electrode layer arranged in these both sides, and an air electrode layer, and supplying air or oxygen to an air electrode layer. Furthermore, since it constituted so that either or the both sides of power which the mechanical power which an engine generates, or a fuel cell module generates might be outputted If an engine is put into operation, an engine will generate mechanical power, and if a fuel cell module reaches predetermined temperature, the fuel gas which reformed the hydrocarbon is supplied to a fuel cell module with air or oxygen, and a fuel cell module will start a generation of electrical energy, and will generate power. At a certain time, the power which a fuel cell module generates comes out enough, an engine is suspended, and when the output which a fuel cell module generates is insufficient, the mechanical power which puts an engine into operation and this engine generates is outputted. Moreover, as compared with the conventional fuel cell generation-of-electrical-energy system using the methanol which cannot be refueled, the gasoline which can be refueled in the usual gas station can be used by this invention in the usual gas station as a raw material of the fuel gas supplied to a fuel cell module.

[0053] Moreover, with the heat of the above-mentioned exhaust gas, if a fuel cell module is heated and it constitutes possible [starting] with the exhaust gas discharged from the engine, since it goes up to the temperature which can start a fuel cell module, the generation of electrical energy of a fuel cell module will be attained. Moreover, if it constitutes so that the mechanical power which an engine generates may be changed into power with a generator and may be outputted and an engine will be put into operation, a generator will drive with an engine and power will be generated. Consequently, the power which a fuel cell module generates comes out enough, an engine is suspended, and at a certain time, when the power which a fuel cell module generates is insufficient, an engine is put into operation, and the mechanical power which an engine generates is changed into power with a generator, and is outputted.

[0054] Moreover, the power stored in the rechargeable battery when it constituted so that the power which either or the both sides of a fuel cell module or a generator generates might be stored in a rechargeable battery and an output was insufficient is outputted, and when the power which a fuel cell module or a generator generates is in a complementary, the power which a fuel cell module or a generator generates is stored in a rechargeable battery. Moreover, if it constitutes so that one sort chosen from the group which consists of a fuel cell module, a generator, and a rechargeable battery, or two sorts or more of power to generate may be outputted to an electrical machinery and apparatus and this electrical machinery and apparatus may be driven with the above-mentioned power The power outputted to an electrical machinery and apparatus comes out from a fuel cell module enough, and an engine is suspended at a certain time, and when the power outputted to an electrical machinery and apparatus is insufficient, an engine is put into operation, the mechanical power which an engine generates is changed into power with a generator, and it outputs to an electrical machinery and apparatus.

[0055] Moreover, if the fuel gas supplied to a generation-of-electrical-energy cel is reformed with the exhaust gas discharged from the engine, fuel gas will become the optimal low hydrocarbon group for generating operation. Moreover, the oxidant gas which fuel preheating tubing and oxidizing agent preheating tubing are formed in a fuel cell module, and the exhaust gas discharged from the engine preheats oxidizing agent preheating tubing, and passes along oxidizing agent preheating tubing is heated. Since refining of the hydrocarbon containing the steam which the exhaust gas discharged from the engine preheats fuel preheating tubing, and passes along the inside of fuel preheating tubing is carried out, by supplying the above-mentioned fuel gas and oxidizing agent gas to a generation-of-electrical-energy cel, the whole fuel cell module goes up to the optimal temperature promptly, and the generation of electrical energy of it is attained. Moreover, if a refining particle is filled up with the consistency in which a hydrocarbon can circulate in fuel preheating tubing, the fuel gas containing a steam will contact a refining particle within fuel preheating tubing, and refining will be carried out to a low hydrocarbon group's fuel gas etc., and it will be supplied to a generation-of-electrical-energy cel.

[0056] Moreover, engine exhaust gas is introduced into the case for refining of a refining machine, and if the reformer tube held in this case for refining is filled up with a refining particle and a hydrocarbon will flow into a reformer tube with water, this hydrocarbon and water will be heated with the exhaust gas of the above-mentioned engine, will be evaporated, and will become fuel gas containing a steam. Consequently, refining of the fuel gas containing the above-mentioned steam is efficiently carried out to a low hydrocarbon group's fuel gas etc. with a refining vessel. Moreover, since the refining machine is formed near the fuel module, the heat which a refining machine generates from a fuel module at the time of a generation of electrical energy is absorbed, and refining of the fuel gas containing a steam is carried out still more efficiently to a low hydrocarbon group's fuel gas etc. by the refining particle within a reformer tube.

[0057] Moreover, while becoming fuel gas which evaporates promptly and contains a steam since the hydrocarbon and water in the reformer tube of a refining machine are heated not only by engine exhaust gas but by the 1st auxiliary heater if the reformer tube in a refining machine is heated with the 1st auxiliary heater, the fuel gas containing this steam contacts a refining particle within a reformer tube, and refining is promptly carried out to a low hydrocarbon group's fuel gas etc. Moreover, if fuel preheating tubing and oxidizing agent preheating tubing in a fuel cell module are heated with the 2nd auxiliary heater, since fuel gas and oxidizing agent gas will be heated not only by engine exhaust gas but by the 2nd auxiliary heater, after [for a generation of electrical energy / optimal] being comparatively heated by the elevated temperature, a generation-of-electrical-energy cel is supplied.

[0058] Moreover, if fuel preheating tubing is supplied, or the high-melting hydrocarbon which is a liquid is injected in the shape of a fog with a fuel injector in ordinary temperature among hydrocarbons, water is injected in the shape of a fog with a water-injection vessel and a fuel feed pipe is supplied, the fuel or water of a liquid is promptly vaporizable. Furthermore, the module temperature sensor which detects the temperature of this fuel cell module is inserted in a fuel cell module, and if a controller controls a fuel cell module and starts generating operation when a module temperature sensor detects that the fuel cell module was heated by engine exhaust gas, and reached the temperature which can be generated, it can generate electricity efficiently with a fuel cell module.

[Translation done.]